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Application of:

## Qualification Highlights

- A senior IT executive with an in-depth knowledge of all aspects of federal information technology management including security, capital planning and investment control (CPIC), enterprise architecture, contracting, budget, technical operations, and human resources.
- Significant experience in the management of large-scale enterprise networks within a federated agency work environment and multi-million dollar budgets.
- Proven ability and multiple years of direct experience in collaboration and building coalitions in large enterprise environments to deliver tailored IT solutions that meet business needs.

# Management Positions

# Veteran Affairs, 2013 – Present, Deputy Director, Health Informatics/Veterans Health Administration (VHA)

As Deputy Director of Health Informatics (HI), I oversee and direct operational support for 8 health informatics programs. These programs total 200 FTEs, supported by approximately 300 contractors. I am responsible for the development of annual program work plans, budget initiatives, operating policy, contract acquisitions, training, strategic planning, and human resources. In this capacity, I have also served as a liaison between VHA, VHA field providers, and OIT.

- Worked closely with the clinical and IT field to establish and support increased communication and organizational relationships with end users through the establishment of the health informatics group.
- I worked with field leadership and Office of Information Technology (OIT) to identify those VHA IT systems considered mission-critical and develop a process to alert VHA stakeholders of IT service disruptions.
- I have successfully worked with multiple stakeholders to support and inform the IT strategy
  at the VHA. Health Informatics works closely with the field stakeholders, including the
  Clinical Application Coordinators, the Field Health Informatics Leadership (FHIL), and the
  health informatics group. I work closely with the clinical community through health
  informatics offices to ensure that IT solutions are being developed that meet the needs of the
  health care team.
- Developed work management process for all HI program offices. This included development
  of annual schedules for development of program work plans, spend plans, and acquisitions.
- Developed a performance metric review process for all HI program offices. Oversee program office development of quantifiable performance metrics that are directly related to strategic and tactical goals. Program performance metrics are reviewed on a quarterly basis and successful performance is also incorporated into employee performance plans.
- Developed the first Communication Plan for the Health Informatics office to ensure a strategic and thoughtful approach was implemented in communicating with clinical and field stakeholders.
- Serve as a VHA liaison with OIT on a variety of issues such as the migration to Microsoft Office 365, management of VHA applications hosted in OIT data centers, security of MFDs, response to IT service disruptions, and improving information flow between VHA and OIT.
- Led an effort to quantify the impact of a data center outage on medical business operations and veterans.

- Led efforts to reorganize HI that resulted in improved efficiencies and reduction of silo work efforts.
- Successfully used the performance improvement plan (PIP) process to identify performance weaknesses and establish a plan for employee improvement in these areas.
- Established an interoperability office within HI to support clinical interoperability efforts in a coordinated manner

#### Health and Human Services, 2007 - 2012

## 2011-2012, Director, Information Technology and Infrastructure Operations (ITIO)

I was responsible for IT operations and management supporting the Office of the Secretary and the offices of HHS Assistant Secretaries. The federated environment required me to engage in extensive collaboration and consensus building to successfully implement IT improvements. I was responsible for all aspects of budget preparation, OMB reporting, human resources, technological planning and implementation and oversight of the \$400M primary IT support services contract for HHS. In addition, I also managed the HHS network, the HHS-wide email system, the HHS data center, seat management (to include help desk operations), infrastructure support, business application hosting, and COOP support. Specific accomplishments included:

- Undertook initiatives to improve customer relationships and opportunities to improve
  collaboration. This included implementation of monthly customer service meetings,
  inclusion of customers to change control board meetings, and development of a customer
  portal to streamline IT purchases by end-users. Customer satisfaction increased significantly
  as measured by annual customer surveys during my tenure as Director.
- Led efforts to more fully support and manage a virtual workforce. Implemented iPad pilot
  and began testing of mobile device management solutions to ensure network security.
  Worked with all stakeholders to obtain consensus in a technical solution for the enterprise.
  Led efforts to develop a BYOD agency policy that required coordination with all
  stakeholders to include union representatives due to possible changes in work environment.
- I successfully guided efforts to evaluate migration of the HHS Office of the Secretary (OS) to a virtualized desktop infrastructure (VDI) for 12,000 users. This included business case development, identification of technical and end-user requirements, and subsequent approval for funding and implementation of VDI pilot within HHS OS.
- Developed dashboard review process to ensure contract performance metrics were evaluated on a monthly basis and accessible for customer review.
- Successfully guided work that culminated in successful implementation of two-factor authentication for network access with employee PIV cards.
- Oversaw efforts to resolve multiple contractual issues between vendor and customers that resulted in a significant savings to the government in disincentives applied to contract performance.
- Coordinated and guided team efforts to begin the process for a re-compete of the \$400M primary HHS IT support services contract.
- Developed HHS policy to mandate network integration across HHS divisions (FDA, CDC, NIH).
- Oversaw and guided efforts to resolve security issues associated with MFDs on the HHS network.

# 2007-2011, Chief Information Officer/Deputy Chief Information Officer (DCIO), Indian Health Service/HHS

As CIO and DCIO, I was responsible for supervision of government and contractor personnel, vendor contracts, budget, plans and policies, training, technical design, network operations, maintenance, security, strategic planning, and day-to-day information technology operations. The IHS network connects 25,000 users located throughout the United States and is supported by staff of approximately 50 federal employees and 150 contractors. Because my office also provided support to independent Tribal nations, this position required expert skills in consultation/collaboration, building coalitions, obtaining consensus, and maintaining effective relationships. I was responsible for all aspects of enterprise IT management and policy for the agency.

- I worked closely with health care leadership to ensure that appropriate and adequate IT tools
  were available for the health care teams. Clinical leadership was intimately involved in IT
  investment decisions and the CIO office worked to ensure that investment prioritization
  reflected the needs and goals of the clinical community.
- Led efforts to improve overall network security that included implementation of multi-factor authentication for remote users, formal development of a log analysis program, penetration testing, and implementation of a vulnerability management program.
- Managed the upgrade of IT operations in a variety of areas to enhance security and reliability. This included emergency power (UPS and diesel generator), storage area network, asset management and patch management, switch and router upgrade, domain controller upgrade, two-factor authentication, and encrypted communications.
- Led efforts to standardize equipment and software and to ensure consistency with the IHS
  enterprise architecture and associated Technical Reference Model.
- Oversaw revisions to procedures and format and content guidance to improve the efficiency and reduce costs associated with the certification and accreditation (C&A) process used within IHS. These efforts saved the agency roughly \$3 million annually in C&A costs.
- Developed process for improved asset management and the refresh of all desktops/laptops, servers, and other network devices. Initiated membership with the Federal Electronics Challenge to formalize sustainability and "Go Green" efforts.
- Conducted a review of agency continuity of operations (COOP) plans. As a result of these reviews, undertook actions to expand and improve the storage area network (SAN) capabilities and enhance emergency power capabilities for key data centers.
- Successfully lead federal government initiatives for IHS including the Trusted Internet Connection (TIC), IPv6, Networx, data center consolidation, and sustainability. Work required close coordination with Regional offices and Tribal nation end-users.
- Extensive understanding of the CPIC governance process and EPLC life cycle model.
   Served as Chairman of the Technical Review Board for IHS. Supervised IT investments that were consistently ranked in the top ten of HHS IT Investment Review Board Performance and Quality Ranked Portfolios. RPMS (HIT solution for Indian Health), one of the largest IT investments within DHHS, was ranked as the number one investment two years in a row by OMB during my tenure.
- Led the re-organization of the OIT office. This reorganization significantly improved
  operations and internal communications by re-aligning personnel in divisions based on skills.
  Reorganization activities required coordination with employee union officials, senior IHS

- executives, and announcement in the Federal Register. Successfully led efforts to transition key positions from contractor to federal employee.
- Successfully used the performance improvement plan (PIP) process to identify performance weaknesses and establish a plan for employee improvement in these areas. Employee performance improved from unsuccessful to fully successful.

## Smithsonian Institution, 2003-2007, Deputy, Network Management Division

Responsible for all aspects associated with the operation and maintenance of the Smithsonian Institution (SI) enterprise converged network. The SI network supports roughly 7,000 staff in locations throughout the United States and Panama. Responsibilities included supervision of government and contractor personnel, budget, plans and policies, training, technical design, project implementation, and day-to-day operations. Museums maintained their own independent staff so success required close collaboration with other SI IT stakeholders.

- Responsible for the complete upgrade of the SI data network. This included network
  infrastructure (fiber, cable, and electrical power) and network components (switches, routers,
  and emergency power supplies). Approximately 400 switches and routers were replaced in
  28 different geographic locations. Developed process for the review, analysis, and
  subsequent upgrade of the data network. Implemented design to enhance overall network
  reliability and redundancy.
- Delivered frequent presentations to internal and external audiences. Extensive experience in making presentations to senior management. Delivered briefings to the Smithsonian Secretary and Under-Secretary on the VoIP and network upgrade programs. Developed and delivered presentations as a speaker at information technology conferences. Delivered presentations on converged network operations at IP Comm and also at the Gartner IT CIO Symposium.
- Successfully developed and implemented a plan that merged telecommunications staff with network operations staff. This action avoided the cost of hiring three additional staff to operate a newly installed telephony solution for SI.
- Develop budget plans and Exhibit 300 to support the Smithsonian telecommunications budget.
- Managed the relocation of the SI's data center from Washington DC to Virginia. This
  relocation involved the move of over 500 devices, including switches, routers, servers, and
  SAN devices. Supervised roughly 50 IT personnel involved in the shutdown, startup, and
  system testing of relocated equipment. Oversaw the development of all schedules,
  procedures, and documents used in the relocation. As a result of these efforts the data center
  was successfully relocated with minimum outage time and disruption to SI staff.

Northrop Grumman Information Technologies, 2000-2003, Services Program Manager Responsible for the successful management of complex IT projects requiring the use of multi-disciplined project teams. Responsible for all aspects of program and project management for a variety of federal clients.

 Successfully managed the first large-scale VoIP deployment in the federal government for the U.S. Bureau of Census. Responsible for all aspects of the development and implementation of the methodology used to successfully migrate Census Bureau to VoIP (approximately 5,000 users). Successfully integrated federal employees and other contractor organizations into a single deployment team. All VoIP installations were completed on or

- ahead of schedule with a high level of customer satisfaction and the project was completed under the original budget estimate. As a result of this successful deployment, Northrop Grumman was selected to manage the VoIP deployment for all regional Census offices throughout the United States.
- Supervised the development and implementation of an enterprise network management
  upgrade for the United States Marine Corps. Developed and implemented a training program
  to address the installation and configuration of new network software that included Solaris,
  Network Node Manager, and CiscoWorks. Coordinated deployment of network upgrade at
  USMC sites located throughout the world. Made improvements to streamline project
  operation that resulted in increased profit margins and significantly improved customer
  satisfaction. Recognized by Hewlett-Packard with the Network Management Crystal Award
  in 2002 for superior implementation of network management technology.
- Developed the Project Management Policies and Procedures Guide used by the Northrop Grumman Information Technology Computing Systems organization to manage all service projects. This guide addresses all aspects of project management including organizational roles and responsibilities, financial management, quality assurance, project communications and reporting, customer satisfaction, and resource allocation. Assisted in the development of a Remedy-based solution for all project and financial reporting requirements.

# SCIENTECH, Inc. 1990 - 2000, Project Director

Technical director for engineering projects for federal and commercial clients. Developed project scope and implementation plans based on client needs and objectives. Responsible for all aspects of project financial and personnel management. Position required the management of highly skilled, multi-disciplined technical project teams consisting of senior in-house scientists and engineers and close interaction with senior non-technical clients

## Comsys Inc., 1988-1990, District Sales Manager

Responsible for expanding IT support sales and coordinating the delivery of IT teams to provide on-site support. Consistently exceeded sales goals and business penetration. Expanded support service staff by over 50% during this time

#### KPMG, 1987-1988, Financial Consultant

Responsible for the financial management of a multi-million dollar DOD weapons system, development of program operations budget, and briefings used in congressional testimony.

## U.S. Navy, 1982-1987, Submarine Naval Officer

Qualified in submarines and responsible for the operation and maintenance of a nuclear power plant, support, and weapons systems while serving on board a U.S. nuclear submarine. Awarded the Navy Achievement Medal and Battle E for superior performance. Naval Political Action Officer responsible for performing naval political analysis, developing and briefing issue papers for Naval Flag Officers, including the Chief of Naval Operations.

#### **Executive Core Qualifications**

## Leading Change

As Deputy CIO, I was responsible for help desk operations across the U.S. supporting roughly 25,000 users. I discovered that help desk operations were decentralized and that IT staff had difficulty accurately tracking IT support service requested by our customers. I determined the root cause to be the use of an outdated help desk application that was no longer supported by the vendor and incapable of providing reports needed by IT managers to manage their staff and workload. I also found out that OIT operated without any clearly defined Service Level Agreements (SLAs) or customer service feedback mechanism. These deficiencies were key contributors to the crisis management that often occurred in our organization and unsatisfactory customer service. I decided to initiate a complete overhaul of our helpdesk operations.

- I met with the division directors and OIT staff to explain my vision for the new centralized help desk operation. I rolled this plan out to my staff at the beginning of the year and the objective was to implement a new help desk complete with SLAs and all required operating procedures by the fall.
- To ensure staff understood the importance of this effort, I also linked key project milestones to the performance appraisal plans for my management team.
- I tasked division directors with the review of their operations and development of SLAs. I also held meetings with the field IT staff.
- I worked closely with field managers to ensure they felt like stakeholders in the process. I delegated review of field help desk operations to the OIT help desk manager.
- I guided the review of COTS helpdesk applications and in parallel with these efforts, I
  contacted help desk managers in other federal agencies for input.
- I took existing help desk procedures used at other agencies and modified them for use within
  my agency. This effort saved us a considerable amount of time and money and also provided
  us with a product that had been battle-tested and was known to be successful. I tasked the help
  desk manager with development of an implementation and training plan for all staff who would
  be using this new system.
- The new help desk process and SLAs were successfully phased into use over a one month
  period. This time allowed staff to become familiar with the new application and also allowed
  us to make minor changes based on lessons learned. Help desk performance and customer
  satisfaction improved dramatically. Results from the new automated customer survey system
  indicated that the vast majority of our customers were very satisfied with the response they
  were now receiving from the IT staff.

#### Leading People

As DCIO I became aware that one of our primary offices suffered from a major morale issue. This impression was also confirmed in the results of a Human Capital survey. The main cause appeared to be a lack of management attention. The problem was compounded by the fact that the office was located in New Mexico and the executive management team, including myself, worked in Washington DC. I undertook a number of initiatives to try to improve this situation.

- I committed to ensuring that either the CIO or I would be present for monthly staff meetings. I
  required division directors to hold at least monthly staff meeting with their divisions.
- I had discovered the office had set aside funds for on-the-spot awards, but they were seldom used. I significantly increased the use of awards to recognize superior performance.
- I also determined a similar situation regarding training funds. I developed an individual development training plan for use within our office. This plan required division directors to

- meet with their staff, establish training needs for the year, and follow through with staff training as appropriate.
- The objective of these initiatives was successfully met as evidenced by the next Human Capital survey. The survey showed a marked improvement in the positive attitude that employees felt towards the organization and their supervisors.

From my review of the Human Capital Survey results and from discussions with staff I also recognized there was confusion regarding branch and staff roles and responsibilities. I took concrete steps to improve this situation.

- I worked with division directors and the CIO to move from a matrix-based organization to a more conventional functional alignment of staff. This design more clearly identified staff roles and responsibilities and also enhanced supervisor management. I presented this reorganization to staff where it was met with a positive response. I also successfully worked with the union to answer questions and resolve concerns they had regarding our reorganization. The reorganization was formalized and announced in the federal register. Once implemented, employees had a much better sense of the objectives of their respective divisions and their work as individuals. Managers noted that roles and responsibilities were more clearly defined and this allowed staff to focus on completing the work and not on trying to figure out who should get the work done.
- I completely overhauled performance plan elements and standards. I worked with division directors on creating performance-based appraisal plans that could be used by employees to guide their work throughout the year. I also ensured that the performance-based plans that were tied directly back to annual office goals.
- As a result of these initiatives office productivity improved greatly as did staff understanding
  of their respective roles in the organization.

#### Results Driven

When I joined the Smithsonian Institution (SI), work had begun on migrating SI from 58 different telephone systems to a single voice over IP (VoIP) telephony solution. A pilot VoIP project had just been completed, but the pilot had not gone well. I realized that the project lacked many of the necessary ingredients to be successful. There was no overall strategy on how the migration was to occur, no standardized policies or procedures, and inadequate communication between the contractor and SI employees and between the VoIP team and the end user community. I initiated a number of changes to get this program on-track.

- I developed an overall migration schedule that provided milestones and completion dates for all activities. This schedule was developed with input from contractors and in-house staff to ensure buy-in from all stakeholders. I developed a responsibilities matrix which listed all activities that would need to be performed by the VoIP team and who was responsible for completing each activity. In addition, the entire migration was reviewed in a series of meetings with the VoIP team. The result of these meetings was a list of project documents that would be created by the team to guide and document project activities.
- I designed the program schedule to allow for multiple sites to be in the VoIP migration process at any one time. By maintaining five to six facilities in the pipeline I was able to minimize contractor downtime which significantly reduced costs. This schedule also allowed us to accelerate program completion.
- I developed or guided the development of technical program documentation associated with design and implementation. I developed level-of-effort metrics and detailed project plans that

proved to be instrumental in keeping programs on schedule and within budget. These tools also provided an early warning for situations that could result in project delays or cost overruns.

- I also developed a process to ensure enhanced communication with end-users. This process
  included a kick-off presentation for managers, workshops on VoIP configurations,
  development of web-based training materials, and use of internal training to assist end-users in
  the migration to the new technology. End-users not only understood what was expected of
  them, but why their participation was critical for success.
- The results of all these efforts resulted in the seamless transition to a new phone system with
  essentially no disruptions to staff work. The project was completed on schedule and under
  budget. The CIO of the Smithsonian Institution noted that the VoIP migration program was
  the most successful program implemented during his tenure at SI.

When I took over as the Director of ITIO, a CURE notice had just been issued to the primary contractor responsible for providing IT services to the IIIS Office of the Secretary and other Assistant Secretary Offices. A CURE notice is the first step in terminating a vendor for nonconformance of contracted services. Given the critical nature of support provided by the contractor (\$400M multi-year support contract), termination was not my first option. I was also aware, that staff did not interact with the contractors in a professional manner and that nine contractor program managers had cycled through the organization in the past two years. I believed that this poor working relationship and also contributed to the problem. I realized I would have to work with my staff to change their interactions with the contractor.

- I set my expectations by example and interacted with the contractor in a professional manner and made it very clear to my staff that I expected the same from them.
- I provided detailed guidance to the contractor on the various plans I expected to see and the
  objectives that needed to be met in order to be successful.
- I assigned staff to each contractor work activity and made it clear that they needed to work
  with the contractor to help them improve performance.
- I implemented weekly CURE meetings with my staff and the contractor. During these
  meetings I would ask both the staff and contractors assigned to improvement areas to brief on
  the progress made. By creating a team framework that included both contractors and federal
  staff, I was able to significantly reduce the negative perceptions that many of my staff had of
  the contractor. By working closely with the contractor management team, I was able to ensure
  they understood the expectations and objectives for success.
- I maintained an open door policy for both the contractor program manager and my key staff to
  ensure that questions or concerns were resolved as quickly as possible.
- As a result of these actions, the contractor was able to successfully meet all of the objectives
  required to rescind the CURE notice. In addition, the relationship between staff and
  contractors improved significantly during this time because I had required them to work as a
  team.

#### **Business Acumen**

When I first joined HHS, all operating divisions (CDC, FDA, NIH, etc) were required to use a centralized email system. The HHS email system was known for being unreliable and also very expensive. Eventually the HHS policy was relaxed and I used this opportunity to lobby for a new email system for IHS.

- I guided the initial efforts that focused on a technical and financial analysis of our existing
  email system and possible alternatives. This analysis demonstrated we could operate a more
  reliable email system offering users larger mailboxes at a reduced cost. This business case was
  presented to executive IHS management who agreed with our approach and formally approved
  our exit from the HHS email system.
- Subsequent work focused on the analysis of alternatives in deployment of an IHS email system. We examined the possibility of outsourcing all aspects of a new email system and also performing all work in-house. Ultimately, the most cost-effective solution combined the use of outside experts in assisting in the actual migration, and using in-house staff to maintain the new email system.
- I provided guidance to the migration team in the development of a detailed project plan, finalization of equipment, end-user communication plan, and migration schedule. I guided efforts to determine the resources required to successfully maintain and operate this system.
- I worked closely with Human Resources to develop all the required documentation to ensure
  the timely addition of new federal hires. As a result of these efforts, we were able to identify
  and hire four additional personnel with the requisite skill sets by the time our new email system
  became operational.
- As a result of the detailed planning I had required of my staff, we successfully completed
  proof-of-concept testing in four weeks and successfully migrated approximately 18,000
  mailboxes in 3 months. All work was completed on schedule, under budget, and with minimal
  disruption to end-users. The IHS email system proved to be a major success and was able to
  provide users with improved reliability and expanded email storage at a cost less than what had
  previously been provided by the centralized HHS mail system.

# **Building Coalitions**

One of the security initiatives that I managed at HHS was the development and implementation of an Inter-Connect Security Agreement (ISA). The ISA is a federal requirement that must be met to allow external parties access to an agency network. In this case, the ISA would be for use between my agency and Tribal sites wishing to connect to the IHS network. This was an extremely important project that was also politically sensitive because we would be placing new requirements on Tribes. The development of this agreement was complicated by the fact that it would be implemented primarily by the IHS Area offices (the Area IT offices were semi-autonomous units that did not fall directly under the OIT chain-of-command). To be successful, I knew I would have to ensure that that the concerns of all stakeholders were addressed in the final policy.

- I developed a working committee that included representation from all stakeholders, including Tribes. The purpose of the working committee was to review and comment on all OIT work products associated with the Agreement. Using this process, I hoped the stakeholders would feel a sense of ownership on the final work product and be advocates for the final policy.
- In parallel with this effort, I worked with the Office of the Inspector General to obtain a legal
  opinion on the applicability of federal security requirements to Tribal nations. This opinion
  was important for defining the type of information we would require in the ISA and lent
  additional credibility to the final work product.
- I also worked closely with Area IT representatives to design an agreement that would be easy for them to implement. Out of this process we developed three ISA templates that could be

- used by Area offices. The three templates addressed the most common type of interconnects IHS maintained with Tribal sites.
- The negotiations required to develop this policy were time-consuming, but necessary and the
  entire process was very iterative in nature to ensure all comments were adequately addressed in
  the agreement and associated policy. Once my team had developed a technically sound
  document that was approved by all working committee members, I sent the ISA out for
  national Tribal review and comment.
- By using an inclusive and transparent approach, we had no major dissenting comments to the proposed policy. It was subsequently signed as final agency policy by the Director of IHS. When I became director of ITIO, it became apparent to me that my office had a generally poor relationship with the Assistant Secretary offices that we supported. Staff had become used to this situation and blamed the poor relationship on customers. This poor relationship also was the key contributor to issues that resulted when fee increases were necessary (ITIO was a fee-based organization and our customer offices had to approve any fee changes). I made it an office goal to change this relationship.
- I initiated a monthly customer meeting and encouraged customers to attend in person versus calling in to the meeting. I set an agenda that required each of my divisions to report on work in progress or planned and to highlight anything that might impact customers. This update was very much needed and allowed customers time to comment or raise concerns about upcoming activities. I ensured that customer issues were documented during each meeting and developed an action list for my staff. Assignments were made and I held the ITIO directors responsible for tracking and resolving each issue. Within six months this meeting became a constructive platform for the exchange of ideas between customers and ITIO staff.
- As part of the effort to improve communications, I made it a personal goal to meet annually
  with the IT Directors for every office we supported. I timed these meetings to occur two
  months before we met with all offices to review fee adjustments. This allowed me to meet
  with each office and explain rate changes in greater detail and ensure all of their questions
  were answered. And similar to monthly customer meetings, I documented all issues and
  concerns from these meetings. Action lists were developed and ITIO Directors were held
  responsible for resolution of issues in a timely manner.
- I reviewed office standard operating procedures to ensure customer needs were adequately
  addressed in any activities that might impact them and that the appropriate level of
  communication was established. In some instances, we asked our customers to participate in
  this review process.
- These changes dramatically improved interactions between my staff and customers. Close communication between my office and customers also resulted in a greater customer understanding of our cost drivers and significantly reduced the issues and concerns associated with fee increases. In subsequent budget meetings, proposed fee increases were unanimously approved by board members.

#### Education and Specialized Training

Senior Executive Fellow, 2015 Federal CIO Certification, 2009 MS, Technology Management, 1995 U.S. Navy Nuclear Power Officers School, 1984 BS, Engineering, 1982